

STAAR PHYSICS REFERENCE MATERIALS



FORCE AND MOTION

$$\text{Average velocity} = \frac{\text{displacement}}{\text{change in time}} \qquad v_{\text{avg}} = \frac{\Delta d}{\Delta t}$$

$$\text{Acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{change in time}} \qquad a = \frac{v_f - v_i}{\Delta t}$$

$$\text{Acceleration} = \frac{(\text{final velocity})^2 - (\text{initial velocity})^2}{2(\text{displacement})} \qquad a = \frac{v_f^2 - v_i^2}{2\Delta d}$$

$$\text{Displacement} = \left(\text{initial velocity} \right) \left(\text{change in time} \right) + \frac{1}{2} (\text{acceleration}) \left(\text{change in time} \right)^2 \qquad \Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\text{Centripetal acceleration} = \frac{(\text{tangential velocity})^2}{\text{radius}} \qquad a_c = \frac{v_t^2}{r}$$

$$\text{Net force} = (\text{mass})(\text{acceleration}) \qquad F_{\text{net}} = ma$$

$$\text{Work} = (\text{force})(\text{distance}) \qquad W = Fd$$

$$\text{Torque} = (\text{force})(\text{lever arm}) \qquad \tau = Fr$$

$$\text{Power} = \frac{\text{work}}{\text{time}} \qquad P = \frac{W}{t}$$

$$\text{Pythagorean theorem} \qquad a^2 + b^2 = c^2$$

GRAVITATIONAL, ELECTRICAL, AND MAGNETIC FORCES

$$\text{Force of gravitational attraction between 2 objects} = \left(\text{universal gravitation constant} \right) \left(\frac{\left(\text{mass of 1st object} \right) \left(\text{mass of 2nd object} \right)}{\left(\text{distance between centers of objects} \right)^2} \right) \qquad F_g = G \left(\frac{m_1 m_2}{d^2} \right)$$

$$\text{Force between 2 charged particles} = \left(\text{Coulomb's constant} \right) \left(\frac{\left(\text{charge of 1st particle} \right) \left(\text{charge of 2nd particle} \right)}{\left(\text{distance between particles} \right)^2} \right) \qquad F_{\text{electric}} = k_c \left(\frac{q_1 q_2}{d^2} \right)$$

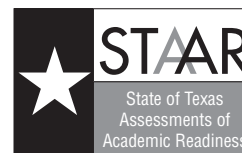
$$\text{Electrical power} = (\text{voltage})(\text{current}) \qquad P = VI$$

$$\text{Current} = \frac{\text{voltage}}{\text{resistance}} \qquad I = \frac{V}{R}$$

$$\text{Equivalent resistance for resistors in series} \qquad R = R_1 + R_2 + R_3 + \dots$$

$$\text{Equivalent resistance for resistors in parallel} \qquad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

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ENERGY AND MOMENTUM

$$\text{Kinetic energy} = \frac{1}{2}(\text{mass})(\text{velocity})^2$$

$$KE = \frac{1}{2}mv^2$$

$$\text{Gravitational potential energy} = (\text{mass})\left(\begin{array}{c} \text{acceleration} \\ \text{due to gravity} \end{array}\right)(\text{height})$$

$$PE_g = mgh$$

$$\text{Elastic potential energy} = \frac{1}{2}\left(\begin{array}{c} \text{spring} \\ \text{constant} \end{array}\right)\left(\begin{array}{c} \text{distance stretched} \\ \text{or compressed} \end{array}\right)^2$$

$$PE_{\text{elastic}} = \frac{1}{2}kx^2$$

$$\text{Energy} = (\text{power})(\text{time})$$

$$E = Pt$$

$$\text{Work} = \text{change in kinetic energy}$$

$$W = \Delta KE$$

$$\text{Mechanical energy} = \text{kinetic energy} + \text{potential energy}$$

$$ME = KE + PE$$

$$\text{Law of conservation of energy}$$

$$KE_i + PE_i = KE_f + PE_f$$

$$\text{Momentum} = (\text{mass})(\text{velocity})$$

$$p = mv$$

$$\text{Impulse} = (\text{force})(\text{change in time}) = (\text{mass})(\text{change in velocity})$$

$$J = F\Delta t = m\Delta v$$

$$\text{Law of conservation of momentum}$$

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$

$$\text{Heat gained or lost} = (\text{mass})\left(\begin{array}{c} \text{specific} \\ \text{heat} \end{array}\right)\left(\begin{array}{c} \text{change in} \\ \text{temperature} \end{array}\right)$$

$$Q = mc_p\Delta T$$

WAVES AND LIGHT

$$\text{Velocity} = (\text{frequency})(\text{wavelength})$$

$$v = f\lambda$$

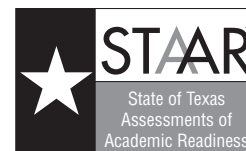
$$\frac{1}{\text{Focal length}} = \frac{1}{\text{distance to image}} + \frac{1}{\text{distance to object}}$$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

$$\text{Energy} = (\text{mass})(\text{speed of light})^2$$

$$E = mc^2$$

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CONSTANTS AND CONVERSIONS

$$c = \text{speed of light} = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$$

$$g = \text{acceleration due to gravity} = 9.8 \frac{\text{m}}{\text{s}^2}$$

$$G = \text{universal gravitation constant} = 6.67 \times 10^{-11} \frac{\text{N} \cdot \text{m}^2}{\text{kg}^2}$$

$$k_C = \text{Coulomb's constant} = 8.99 \times 10^9 \frac{\text{N} \cdot \text{m}^2}{\text{C}^2}$$

$$m_E = \text{mass of Earth} = 5.97 \times 10^{24} \text{ kg}$$

$$r_E = \text{radius of Earth} = 6.37 \times 10^6 \text{ m}$$

$$\text{newton (N)} = \frac{\text{kg} \cdot \text{m}}{\text{s}^2}$$

$$\text{joule (J)} = \text{N} \cdot \text{m}$$

$$\text{watt (W)} = \frac{\text{J}}{\text{s}} = \frac{\text{N} \cdot \text{m}}{\text{s}}$$

$$\text{hertz (Hz)} = \frac{\text{cycle}}{\text{s}}$$

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PERIODIC TABLE OF THE ELEMENTS

	1 1A	2 2A	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9	10	11 1B	12 2B	13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
	1 H 1.008 Hydrogen	2 He 4.003 Helium											5 B 10.812 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998 Fluorine	10 Ne 20.180 Neon
	3 Li 6.941 Lithium	4 Be 9.012 Beryllium											13 Al 26.982 Aluminum	14 Si 28.086 Silicon	15 P 30.974 Phosphorus	16 S 32.066 Sulfur	17 Cl 35.453 Chlorine	18 Ar 39.948 Argon
	19 K 39.098 Potassium	20 Ca 40.078 Calcium	21 Sc 44.956 Scandium	22 Ti 47.867 Titanium	23 V 50.942 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.845 Iron	27 Co 58.933 Cobalt	28 Ni 58.693 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.64 Germanium	33 As 74.922 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
	37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium	39 Y 88.906 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.906 Niobium	42 Mo 95.96 Molybdenum	43 Tc (98) Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.906 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.868 Silver	48 Cd 112.412 Cadmium	49 In 114.818 Indium	50 Sn 118.711 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.904 Iodine	54 Xe 131.294 Xenon
	55 Cs 132.905 Cesium	56 Ba 137.328 Barium	57 La 138.905 Lanthanum	71 Lu 174.967 Lutetium	72 Hf 178.49 Hafnium	73 Ta 180.948 Tantalum	74 W 183.84 Tungsten	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.085 Platinum	79 Au 196.967 Gold	80 Hg 200.59 Mercury	81 Tl 204.383 Thallium	82 Pb 207.2 Lead	83 Bi 208.980 Bismuth	84 Po (209) Polonium	85 At (210) Astatine	86 Rn (222) Radon
	87 Fr (223) Francium	88 Ra (226) Radium	58 Ce 140.116 Cerium	59 Pr 140.908 Praseodymium	60 Nd 144.242 Neodymium	61 Pm (145) Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.925 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.930 Holmium	68 Er 167.259 Erbium	69 Tm 168.934 Thulium	70 Yb 173.055 Ytterbium			
			89 Ac (227) Actinium	90 Th 232.038 Thorium	91 Pa 231.036 Protactinium	92 U 238.029 Uranium	93 Np (237) Neptunium	94 Pu (244) Plutonium	95 Am (243) Americium	96 Cm (247) Curium	97 Bk (247) Berkelium	98 Cf (251) Californium	99 Es (252) Einsteinium	100 Fm (257) Fermium	101 Md (258) Mendelevium	102 No (259) Nobelium		

Atomic number — 14
Symbol — **Si**
Atomic mass — 28.086
Name — Silicon

Mass numbers in parentheses are those of the most stable or most common isotope.

Lanthanide Series

Actinide Series